# Mastermind & Cognitive Development

The intention of this project is to study the type of reasoning used to uncover the hidden pattern presented in the Mastermind game. The study will require creating a computer-based Mastermind game that a user can play. The computer game must be able to evaluate the guesses made by the human player to determine if the player is making a random guess, or if the player is making a “smart” or “reasonable” guess. To accomplish this, there must be a component built into the Mastermind tool that is expert at playing the game.

## The Study’s Essential Questions - Motivating Factors

The questions this study is attempting to address are as follows:

1. Can an age range be identified as a typical age where the type of reasoning required by Mastermind is naturally acquired? It is well-known that babies develop an understanding of object permanence between age range of 4 - 8 months. Does “Mastermind”-reasoning also have a natural age range?
2. If an age range is identified, can children below that age range be taught the logical reasoning concept for solving the game? If so, what are the limits to this? At what age does the teaching no longer work?
3. Can Mastermind be used to measure critical thinking and problem-solving skills?
4. Can Mastermind be used to teach critical thinking and problem-solving skills?
5. Is there a correlation between developed Mastermind reasoning and mathematical understanding? Can success with Mastermind be used to predict success with certain mathematical concepts? Which concepts?

If a student is not developmentally ready to solve Mastermind, pushing certain mathematical concepts on that child may result only in frustration and contribute to the development of a hatred for Mathematics. It could be that some children who feel that “they just can’t do math” maybe very successful if the introduction of certain concepts is delayed until their brains have developed to a point where they might achieve success. The benefit would be an increase in the number of children who feel capable and confident in using mathematics as a tool to solve problems. Children who will go on to further develop their abstract thinking skills.

## Considerations in the development of the Mastermind tool

* How are we going to determine the difference between just a bad move, and someone making random guesses?
* Comments for subjects-how they got through it and
* How can we detect when people drift off of their strategic path?
* Have they played before? How frequently?
* How are we going to determine how bad a particular move is, in relation to the optimal strategy? How will individual moves be scored?
* Do we need to have any other analysis than “stupid move” analysis?
  + <http://mathworld.wolfram.com/Mastermind.html>

### Dividing the Project into various sections and activity groupings

* Research and Develop
  + Strategies
  + Develop a number system for ranking the effectiveness of a move. We will probably need to play a number of games manually and discuss each move in order to develop an appropriate ranking system. This would be best done with the entire team participating and analyzing the game play. I would recommend multiple sessions of this. Q: Do we need to have any other analysis than “stupid move” analysis? What would that be?
* The Game Tools
  + Real time move analysis - as the player makes each move, the analysis engine will determine a ranking (weight) for that move.
  + Creating one set of patterns - what is this???
    - We will calculate the probability of different moves before they play - I’m not sure that is the most effective way of ranking moves - DL
  + Visual setup of board - What is this???
  + Identify “stupid” moves. These would be moves for which evidence from previous moves would prove it to be wrong. What rank for a stupid move?
  + For the “teaching logic” portion of the project, the game will need to be tooled to give hints? (what would that look like?)
    - Pulse a played peg that is in error and pulse the pegs from previous moves that proves that one wrong.
  + Algorithm for result/hints
  + Reset/Win Screen - what is this?
  + Detecting moves
  + Algorithms for techniques
* Testing
  + Find subjects for the study in Elementary, Middle, and High School.
  + Gather State-Test scores in Mathematics for student subjects. We need a way to make them anonymous - yet still distinguish between them.
  + Data Needed: StudentID, Age, Gender, Race, Current Math Level,

# Revision History

2/4/2016 - Initial Meeting - brainstorm Mastermind Questions

2/5/2016 - Begin breaking down tasks

3/15/2016 - DL - Organize this document into logical sections.